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I, JANENE PEISKER, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002952407 for a patent by M.B.T.L. LIMITED as filed on 01 November 2002.

WITNESS my hand this
Twelfth day of November 2003

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AUSTRALIA
Patents Act 1990

PROVISIONAL SPECIFICATION

200295 filed 1st November 2002

Invention Title: **Monitoring On Water Sports**

Applicant: **M.B.T.L. Limited**
[A.C.N 101 650 471]

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The invention is described in the following statement:

MONITORING ON WATER SPORTS

This invention relates to a method and system for monitoring performance characteristics of athletes and watercraft in on water sports such as rowing, kayaking, surf-ski riding and sailing.

Background to the Invention

Monitoring of athletes performance both in training and in competition is important in the development and implementation of new approaches aimed at improving sporting performance.

USA patents 4984986 and 5099689 disclose measuring systems for off water rowing apparatus which measure the number of strokes or the force applied to the machine.

USA patent 6308649 discloses a monitoring system for sail boat racing which provides feedback to the crew of such parameters as wind speed and direction boat speed, sail boat comfort parameters , sail shape, line tensions, rudder angle etc.

Some development of monitoring systems has occurred in non water sports.

USA 6148262 discloses a bike mounted sports computer including a GPS receiver to provide a mapping facility.

It is an object of this invention to provide a device for real time monitoring of both boat and athlete performance in on water sports.

Brief description of the Invention

To this end the present invention provides an on water data logger which includes

a) A movement sensor to sense movement
b) at least one physiological sensor attachable to a human body
c) a control unit to receive the data from the accelerometer and the physiological sensor

d) said control unit being programmed to manipulate the received data and transform it into useful parameters for assessing performance

e) display means for displaying the said parameters

f) storage means for storing the parameters and/or

g) telemetry means for transmitting the parameters to a remote control point

This device will provide longitudinal data from the training and competition environment and provide both athlete physiological data and performance data related to the sport.

For rowing or other on water sports the movement sensor data may be used to produce out puts that correlate to

a) boat speed

b) acceleration or force for each stroke

c) stroke rate

The movement sensor is preferably an accelerometer but may also be an impeller unit to sense velocity or a GPS unit to sense instantaneous boat position and velocity or combinations of these sensors . An impeller may be fitted to the boat hull and its rotations sensed to derive boat speed. A disadvantage of the impeller is that it does impede boat speed and is thus not desirable for use during competition. Alternatively a micro fluid flow sensor may be fitted to the hull to measure the water flow past a point on the hull to determine boat speed. A micro fluid flow sensor would not impede the boat speed. A GPS receiver transmitter may be included in the device to derive location and speed parameters.

The physiological sensors used are attached to the boat crew. Heart rate is the prime parameter to be measured and this may be sensed using electrical sensors or microphones. Respiratory rate is also important and may be measured by sensing the stretching of a chest band or using a microphone and signal recognition software. Another parameter is arterial oxygen saturation which may be measured non invasively by a sensor, placed on an earlobe or finger tip, using pulse oximetry employing an infra red absorption technique, infra spectroscopy may be used for non invasive measurement of blood lactate concentrations.

Detailed description of the Invention

Particular embodiments of the invention will be described.

Figure 1 is a schematic layout of a data logger used for a rower and a rowing shell

Figure 1 illustrates the basic components of a system to monitor boat speed and an oarsman's heart rate.

The accelerometer provides a PWM output where the duty cycle is related to the acceleration. On the rising edge and falling edge of the PWM output, a timer value is captured and used to calculate the accelerometers duty cycle. The firmware also includes an algorithm to adjust for jitter in the PWM period, and for a small amount of drift. A more detailed algorithm that compensates for temperature drift over time has been looked at, and will be implemented at a later date.

The impeller pickup uses a Melexis MLX90215 Hall Effect sensor to detect the rotations of the NK impeller. The MLX90215 is programmed with a sensitivity of 100mV/mT. Output from the sensor is amplified by 100 to increase the signal amplitude to a usable range. This signal is then sampled using an A/D at 1200Hz and processed using DSP techniques within the firmware to calculate rotations.

The display device is a handheld Compaq iPAQ computer programmed to present the data in a form that is useful to a coach or rower

The microprocessor is a Hitachi HD64F3672FP which stems from the H8/300H family. Its main features are:

- eight 32-bit registers OR sixteen 16-bit or sixteen 8-bit
- Serial communication Interface (SCI)
- 10-bit ADC (4 channels)
- 2 kbytes of RAM

The data for 1 block (by 3 or 4 channels) will be packaged and transmitted in a single frame. The sampling time for a frame (1 block at 150 samples/sec) will be equivalent to 6.6ms. This data will be combined with block and channel information.

A total of eight bytes is required to transmit one block of data this includes the header, two 16-bit channels, Impeller Rotation count and Heart Rate count. The Heart Rate count is only transmitted once a second, or one in every 150 frames. Table 1 shows a block of data excluding the framing and network information data.

Table 1

Byte		
	1	Frame headfer(xEE)
	2	Number of Blocks(4 bits) Number of channels (4 bits)
	3	ACC "Y" bits 1-8
	4	ACC "Y" bits 9-16
	5	ACC "X" bits 1-8
	6	ACC "X" bits 9-16
	7	Impeller rotation count (8bits)
	8	Heart rate count (8bits)

Table 2 illustrates an example of the bit stream for 2 frames. The first frame containing two 16-bit channels and Impeller Rotation count, and the second frame containing two 16-bit channels, Impeller Rotation count and Heart Rate count

Table 2

Data Stream	Meaning
0xEE	Header Byte
0x13	One Block, eg.3Channels
0xA9	Acc Y Lower Byte
0xEA	Acc Y Upper Byte
0x46	Acc X Lower Byte
0xC9	Acc X Upper Byte
0x01	Impeller Rotation Count
0xEE	Header Byte
0x14	One Block, eg.4Channels
0xA9	Acc Y Lower Byte
0xEA	Acc Y Upper Byte
0x46	Acc X Lower Byte
0xC9	Acc X Upper Byte
0x01	Impeller Rotation Count
0x02	Heart Rate Count

The data logger unit is powered from a 9Volt battery, which is regulated down to 5volts internally.

The dimensions of the data logger are 25mm x 30mm x 9mm (smaller that the average matchbox). All the chips that have been selected are amongst the smallest available in their range, the Hitachi HD64F3672FP measures on 12mm x 12mm, this incorporates a 64 pin architecture and the ADXL202 measuring only 5mm x 5mm.

A single unit may be used for each crew member or the heart rate lines for each crew member can be included with the accelerometer and speed data to provide a composite set of data. In a multi crew boat each crew member has a receiver within 2 feet that picks up the heart rate signal from the polar heart rate monitor strapped to each crew member. Each heart rate monitor transmits a uniquely coded signal that is assigned to each crew member . the boat data logger

receives the heart rate signals for all crew members by cable from the heart rate receivers

A GPS unit may be integrated with the data logger system. This could comprise two units, current unit plus a second unit for GPS. The units would share the same serial line and communicate using a network protocol. Alternatively the GPS unit could be connected to the current unit and additional firmware code added to receive and retransmit data.

Instead of using an impeller to detect boat speed a water flow sensor may be used. One preferred sensor is a micro PCB or silicon based micro fluid flow sensor that uses a heater in combination with a heat sensor that measures the change in temperature of fluid flowing past the heater and sensor to determine the fluid flow rate which in this case is the water flowing past a fixed point on the boat hull. This can then be used top measure boat speed.

Those skilled in the art will realize that the invention may be implemented in a variety of embodiments depending on the water craft used and the number of personnel in the water craft. A variety of sensors may also be used to gather data applicable to the event and the water craft.

CLAIMS

1. An on water data logger which includes
   a) a movement sensor to sense movement
   b) at least one physiological sensor attachable to a human body
   c) a control unit to receive the data from the movement sensor and the physiological sensor
   d) said control unit being programmed to manipulate the received data and transform it into useful parameters for assessing performance
   e) display means for displaying the said parameters
   f) storage means for storing the parameters and/or
   g) telemetry means for transmitting the parameters to a remote control point

2. An on water data logger as claimed in claim 1 in which the data logger is fitted to a rowing craft and physiological sensors are fitted to each crew member and arranged to communicate with said data logger.

3. An on water data logger as claimed in claim 1 or 2 in which the movement sensor is an accelerometer that is used to derive stroke rate for a rowing craft.

4. An on water data logger as claimed in any preceding claim that also includes a boat speed sensor.

5. An on water data logger as claimed in any preceding claim in which the physiological sensor is a heart rate monitor.

ABSTRACT

A data logger for a rowing shell and crew which includes an accelerometer, an impeller or flow sensor to sense velocity, a GPS unit to sense position and velocity, a heart rate monitor, a controller programmed to manipulate the data and provide a display of the heart rate, boat speed, stroke rate etc. The data can be stored or transmitted to a remote computer for use by the coach.

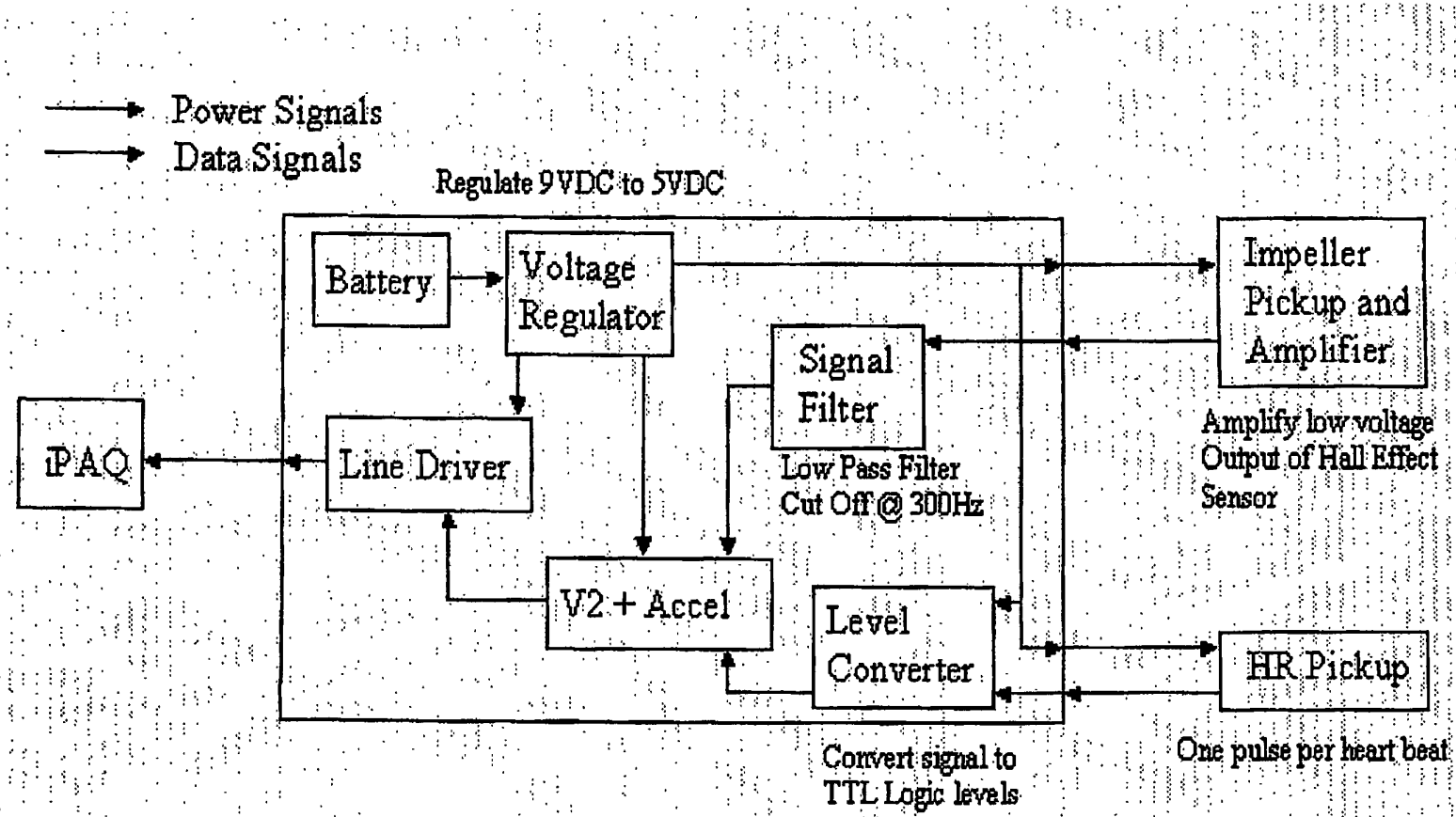

FIGURE 1